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Food Consumption and Anthropometric Assessment Survey of Autism Affected Children, Adolescents and, Adults: A Pilot Study

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ABSTRACT

Background: Autism spectrum disorder (ASD) is referred to a group of complex neuro-developmental disorders, which can be characterized by impairments in social and communication skills as well as repetitive body movements and behaviors. The objective of this study was to examine adequacy of nutrient intake and to determine the scientific nutritional data of ASD individual. **Methods:** In this cross-sectional study, retrospective analysis of 24-hour recall questionnaire and anthropometric data collected from 32 ASD individuals, aged 9-34 years was done. To this point, the participants' weight/height and calorie were measured using a portable weight/height scale and Harris Benedict Energy Equation, respectively. **Results:** According to the findings, 90.62% individuals were carrying more weight than the desire weight. Among different age groups, the highest mean of carbohydrate intake per day was found in the adolescent group with a standard deviation of 212.54 ± 45.45 g. The lowest mean of fat intake per day was found in the child group with a standard deviation of 25.04 ±2.79 g. This study indicated that individuals with ASD had inadequate diets in terms of kilocalories and macronutrients; however, their current body weight was higher than the desirable one. **Conclusion:** This study established scientific nutritional data for the future research and evidence-based studies in Bangladesh. Although several factors may influence the nutritional status, calorie intake, and nutrient intake, choosing foods is the first step to improve the health and well-being.

Keywords: *Utism spectrum disorder; Nutritional status; Feeding behavior; Body weight; Caloric intake*

Introduction

Autism spectrum disorders (ASDs) are a group of complex neuro-developmental disorders characterized by impairments in the social and communication skills as well as repetitive body movements and behaviors (Castillo *et al.*, 2007). The ASDs include autistic disorder, Rett

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syndrome, childhood disintegrative disorder, pervasive developmental disorder-not otherwise specified (PDD-NOS), and Asperger syndrome (Speakes, 2012). According to the publication of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition in May 2013, all autism disorders were merged under one umbrella diagnosis of ASD (American Psychiatric Association, 2013, Speakes, 2012). Cerebral palsy, attention deficit hyperactivity disorder (ADHD), down syndrome, learning disability, intellectual disability etc. are also considered as the same public health crisis.

In 2009, the USA conference of gastroenterology formed a consensus on monitoring of the intestinal disorders in patients with ASD (Autism Society of America, 2009). It was agreed that pediatricians were obliged to perform the routine monitoring of anthropometry as a part of nutritional status assessment in children with ASD. By developing obesity, patients with ASD demonstrate a malnutrition risk due to the inadequate energy intake from the diet and problems caused by improper absorption of nutrients from the intestines as well as indigestion. Any deviation from a normal nutritional status (e.g., overweight, obesity, cachexia) in patients with ASD should be a signal to the specialist for instigating the dietary treatment (Autism Society of America, 2009). As Sadowska et al. stated, it was found that children could become underweight, despite an adequate intake of energy when their daily food rations contain inadequate amounts of dietary fiber, calcium, potassium, iron, and vitamin D(Sadowska and Cierebiej, 2011). In 2009, by analyzing both macro and micro nutrients Herndon et al. found that ASD children were associated with body calcium deficiency to the normal children (Herndon *et al.*, 2009).

In 2007, Levy et al. assessed the influence of individual nutrients on the diet of 62 children with ASD in order to determine whether gastrointestinal disorders in ASD patients were associated with the type of food consumption. The results were compared with the standard RDA levels (recommended dietary allowance) in relation to energy, protein, carbohydrates, and fats. Findings showed that dietary energy, carbohydrate, and fat intakes were within the recommended level, whilst the average dietary protein intakes exceeded the RDA (211%, range: 67-436%). These patients also exhibited negative symptoms of the gastrointestinal system such as diarrhea and constipation. So, the need to describe the relationship between the intake of certain nutrients and occurrence of the gastrointestinal problems was stressed. Furthermore, an important therapeutic element for treating autism was application of a selective diet (Levy *et al.*, 2007).

Ho et al. analyzed the differences related to nutritional status and diet of Canadian children with ASD assessing the contribution of different dietary nutrients, where an individual food intake was determined by consulting with parents and health-care providers. The study showed that obesity may be correlated with increased symptoms of autism (Ho *et al.*, 1997). Curtin et al. studied the prevalence of obesity in children and adolescents with ASD and found that the prevalence of obesity was higher in children with ASD than the healthy ones (30.4% vs. 23.6%). It was also concluded that additional research was required to understand the factors affecting the development of obesity better in this population(Curtin *et al.*, 2010). Eating habits and dietary intake of nutrients in autistic children were also analyzed by Johnson. The results showed behavioral differences between the two groups; however, no significant differences were observed in the nutritional status (Johnson *et al.*, 2008). Similar results were obtained by Schreck et al., indicating significant behavioral problems associated with dietary preferences and food intake of autistic children. Regarding the food intake of autistic children, an adequate intake of fruits, vegetables, dairy products, and starch was found to be effective on these children's behavioral problems (Schreck *et al.*, 2004).

Until recently, autism along with other developmental disabilities, have been regarded as central nervous system diseases. The medical research community has ignored the various other

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disorders coexisting with the autism, such as dysfunction of the gastrointestinal and immunological systems. As a result, patients were treated only by psychiatrists and therapists; as a result, long-term gastrointestinal problems arose, which often became permanent during the patient's lifetime (Autism Society of America, 2009).

Dysfunction of the gastrointestinal system is more common in ASD children compared with the healthy children. Another problem is the diagnosis of symptoms; because most autistic children are not able to inform their parents and/or care-takers about their discomforts caused by gastrointestinal disorders. The Autism Treatment Network (ATN) indicated that gastrointestinal disorders like diarrhea or constipation, occur nearly in half of the ASD children and their incidence increases with age (Kuhlthau *et al.*, 2010). A study conducted by Horvath et al., in 1999 showed the structure and function of the upper gastrointestinal tract in autistic patients with gastrointestinal symptoms. The most common symptoms observed were diarrhea, constipation, and flatulence. In addition, 69.4% of the ASD children suffer from esophageal reflux, gastritis, and duodenal inflammation; where, 58.3% of the ASD children possessed enzyme abnormalities affecting carbohydrate digestion. However, no irregularities were observed in pancreatic function. This study showed the gastro esophageal reflux disease and disturbances in disaccharide mal-absorption that may contribute to disorders of the patients' development (Horvath *et al.*, 1999). Later, Afzal et al. evaluated the incidence of constipation in ASD children associated with gastrointestinal dysfunction with a moderate or severe occurrence of constipation in 36% of children with ASD compared to the control group (9%) (Afzal *et al.*, 2003).

It is very important to make dietary adjustments when treating autism. An appropriate dietary intervention allows for quick relief of the disease symptoms and should be complementary to the pharmacotherapy and behavioral therapy. Reducing the intake of certain food products is associated with reduced incidence of the numerous gastrointestinal symptoms in patients, such as: inflammatory bowel disease, food intolerance and allergies, infections, together with biological and viral infections. So, our main goal was to examine adequacy of nutrient intake and to determine the scientific nutritional data of ASD individual.

Materials and Methods

*Participants***:** The study participants were selected by random sampling method from 'Parents forum of differently able' (PEDA) students' list. A total of 32 persons with ASD within the age range of 7-45 years participated in this study. The eligibility criteria for entering the study included male and female children within the age range of 7-45 years who had previous clinically documented diagnosis of autism, asperger syndrome, or pervasive developmental disorder. Moreover, their parents or legal guardians should have no other medical diagnosis that impact nutrition status. In addition, the participants the participants should have legal nationality of Bangladesh by birth.

Data collection: This is a cross-sectional study to establish scientific nutritional data of the individuals with ASD to conduct an evidence-based action. The 24-hour recall method was used for assessing the dietary consumption pattern as well as dietary diversity of the targeted population group from the pre-selected individual. This study was conducted from November 2017 to March 2018. The dietary recall was taken from both PFDA center and ASD person's home. The parents or caregivers of each child were requested to provide a 24-hour recall for 7 days. The data collection part of this survey covered all foods consumed in the previous day including drinks, snacks, sauces, and salad. The main meals and their cooking method were also included. In addition, the parents or caregivers were asked to include the type of food and beverages consumed out of home. Finally, the parents or caregivers were asked to provide information concerning the modified or restricted diet followed by the individual while the intake history was recorded.

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Anthropometric data were taken two times and the average was calculated. Anthropometric measurements including height and weight were also calculated. Comprehensive nutritional health histories including disease condition, sensitivity to food, drug intake history, medication and supplement use, and gastrointestinal symptoms of the individuals were obtained.

Socio-Demographic characteristics: A structured questionnaire was used to obtain the information on socio-demographic characteristics of the participants such as age, occupation, education, number of children, and household size.

Anthropometric measurements: Weight measurement was performed using a portable bathroom scale to the nearest 0.1 kg while the participants were in light clothes without shoes. Height was measured to the nearest 0.1cm using a portable height to meter with a movable head piece while participants stood erect on bare foot. The weight measurement was done by Tanita scale. We have used manually made height scale for the height measurement.

Desirable body weight: Maintaining a healthy body weight can significantly reduce the risks of diseases and conditions, including heart disease, diabetes, depression, and ASD. The quality of life is also demonstrated by healthy body weight. Here, desirable body weight was used to identify the normal required body weight for the individuals because no valid related data existed in Bangladesh. The desire body weight for children was calculated by the following formula (Tanchoco and Nutritionist-Dietitians' Association of the Philippines, 1994):

DBW (kg) = (Age in years× 2) + 8

Furthermore, the desire body weight for adults was calculated by Tannhauser's Method (Tanchoco and Nutritionist-Dietitians' Association of the Philippines, 1994):

DBW (kg) = (Height in cm-100) –(10% off) ±1

Calculation of total daily nutrient and calorie intakes: The dietary energy intake of the study participants was determined by a 24-hour recall questionnaire and the participants' food intake patterns were measured by a specific food frequency questionnaire for 7 days (Gibson, 2005). The nutrient value of Bangladeshi food was calculated using food composition data published by Dhaka University (Shaheen *et al.*, 2013).

Calculation of total energy requirement: Total energy requirement was calculated using Basal Energy Expenditure (B.E.E.) formula of Harris-Benedict (Harris and Benedict, 1919).

B.E.E. for men = 66.5 + (13.75 x kg) + (5.003 x cm) - (6.775 x age)

B.E.E. for women = 655.1 + (9.563 x kg) + (1.850 x cm) - (4.676 x age)

Activity factor: To determine the total daily calorie needs, several formula of multiplying BMR were used by the appropriate activity factor including sedentary (little or no exercise), lightly active (light exercise/sports 1-3 days/week), moderately active (moderate exercise/sports 3-5 days/week), very active (hard exercise/sports 6-7 days a week), and extra active (very hard exercise/sports & physical job or 2x training) (Tanchoco and Nutritionist-Dietitians' Association of the Philippines, 1994).

Data management and analysis: A structured questionnaire was checked for inconsistency and errors before calculation. All the data were inputted into the Microsoft Office Excel 2007, transferred into the SPSS (IBM SPSS Statistics V21 x86), and analyzed according to the study objectives. For 24-hour dietary recall method, data were manually inputted on SPSS and then data analysis was done. Microsoft Office Excel 2007 was used for the t-test for the two type-sample mean. All other statistical analysis was done by SPSS (IBM SPSS Statistics V21 x86).

Ethical considerations: Participant information sheets and consent forms were prepared in both Bengali and English. The participants' information sheets covered the research nature including its purpose, benefits, and methods. The interview consent form explained that the consent was made for the information provided in the participant

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information sheet. It added that participation was voluntary and the participants could withdrawal from the study at any time. It also clarified confidentiality of information by researchers. The data collection process commenced at the completion of the ethics approval process.

Results

Description of the ASD individuals: A total of 32 participants; 11(34.4%) female and 21(65.6%) male, completed the study.

Comparison between the current and desire weight: Height and weight measurements were recorded for 32 individuals. Later, the desirable body weight was calculated for each participant. In the next stage, all respondents were categorized under three groups. The first group included the children within the age range of 7 to 12 years, the second group consisted of the adolescents aged 13 to 18 years, and the third group included the adults aged 19 to 45 years. In the first group, with only three members, the current weight was greater than the desired weight for all participants. In the second group, both male and female ASD individuals were overweight. This group included adolescents who are more prone to obesity as the most vulnerable group in this study. In this group, we found that three participants had a weight of greater than 100 kg. This may be due to their low physical activities and decreased metabolic rate. In the third group, differences between the current and desire weight were not so high; three respondents had lower current weight than the desire weight, one respondent's current weight was very close to the desire weight (difference 1.8 kg), and the difference between the current and desire weight was not significant in other respondents. We calculated the mean of actual body weight and desired body weight for each age group and plotted a line diagram (**Figure 1**). We also found that the relationship between the current and desired body weight was significant (0.01).

We have calculated mean of the present body weight and desired body weight for both genders and plotted the bar chart (**Figure 2**). We also found that the relationship between the current and desired body weight was not significant (0.12).

Macronutrient intake: **Table 1** shows the descriptive analysis of the carbohydrate, protein, and fat intake per day for age and gender groups. In the age groups, the highest mean protein intake and mean fat intake per day were 64.69 and 37.63 in the adult group, respectively; where, the standard deviation was found to be 15.94 and 18.16 in this regard. Interestingly, the highest mean carbohydrate intake was in the adolescent group (212.54), while the standard deviation was 45.45 in this area. However, the changes of mean macronutrients intake for age groups were not significant. Furthermore, in gender group, we found that the mean of daily macronutrient intake of male was significantly higher than females.

Table 2 shows descriptive analysis of the percentage of calories consumed from carbohydrate, protein, and fat sources through daily diet for age and sex groups. In the age group, the adults had the highest mean percentage of calorie intake from fat among all the three groups; where, the standard deviation was found to be 6.46. However, the relationship of the percentage of calories consumed from carbohydrate, protein, and fat sources with the age groups was not significant. Moreover, the relationship of the calories consumed from carbohydrate, protein, and fat sources with gender was significant.

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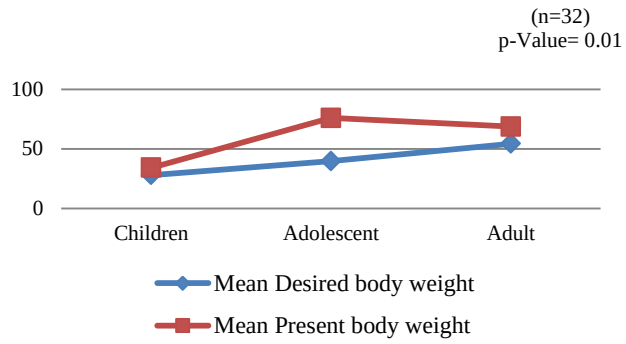

Figure 1. Line diagram on the relation between the present and desire body weight of the adult group

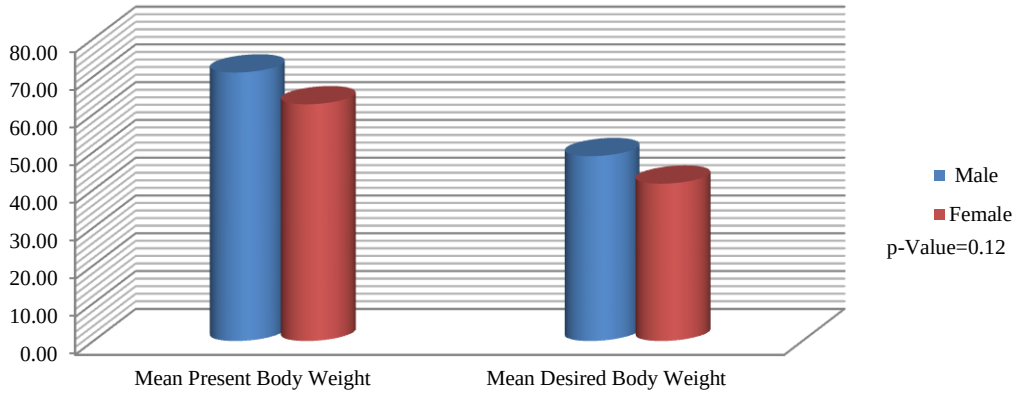

Figure 2. Bar chart shows the relation between current weight and desire body weight of adult group.

Table 1. Mean ± SD of the daily macronutrient intake

Variables	Protein (g)	Fat (g)	Carbohydrate (g)
Age group			
Children	60.21 ± 11.85	25.04 ± 2.79	171.40 ± 13.05
Adolescent	62.10 ± 15.10	35.96 ± 10.89	212.54 ± 45.45
Adult	64.69 ± 15.94	37.63 ± 18.16	196.91±51.39
P-value[a]	0.88	0.42	0.17
Sex			
Male	216.35 ± 43.36	68.83 ± 13.46	40.04 ± 15.27
Female	171.31 ± 41.38	52.50 ± 11.64	27.63 ± 10.05
P-value[b]	0.02	0.02	0.08

[a:] Two-way ANOVA *test*; [b:] Paired t-*test*

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Table 2. Mean ± SD of the calorie source

	From carbohydrate (%)	From protein (%)	From fat (%)
Age group			
Children	59.52 ± 1.74	20.89 ± 3.70	19.59 ± 2.00
Adolescent	59.50 ± 3.90	17.52 ± 1.58	22.98 ± 4.15
Adult	57.96 ± 6.20	18.94 ± 3.30	23.10 ± 6.46
P-value[a]	0.71	0 .15	0.58
Sex			
Male	57.91 ± 5.54	18.53 ± 2.76	23.56 ± 5.86
Female	60.16 ± 4.15	18.70 ± 3.28	21.14 ± 4.11
P-value[b]	0.04	0.001	0.04

[a:] Two-way ANOVA *test*; [b:] Paired t-*test*

Discussion

This cross-sectional study investigated the scientific nutritional data of individual with ASD in Bangladesh. Individuals with autism suffer from poor nutritional status and most of them had inappropriate consumption of micronutrients or calorie intake. Comparison between the current and desire weights showed that the current weight was greater than the desire weight in all age groups.

Similar to our study, Emond et al. and Curtin et al. reported that the ASD children had inadequate energy intake (Curtin *et al.*, 2010, Emond *et al.*, 2010). Considering that the dietary habits can affect these patients' disease status and behaviors, further studies are required to investigate nutritional status of individuals with autism. Furthermore, a study reported about the food refusal incidence of children with autism and explained that this strict adherence to rituals and routines was a core feature of autism (Hyman *et al.*, 2012). We found that ASD individuals with normal body weight consumed lower calorie than their actual calorie needs. Kushak reported similar findings and found decreased levels of disaccharidases and glucoamylase with lactose and sucrose in 55% of children by gastroscopies and biopsies. This causes malabsorption of carbs and intestinal disorder associated with starch metabolism (Kushak and Buie, 2002). To recover from autism, diet should be the first step. To this end, appropriate diet planning can increase the recovery chance of autism. Some certain types of protein including gluten and casein should be avoided because they are known to be troublemakers for individuals with autism.

The study was conducted on the ASD individuals, who were low in number and difficult to deal with. This study was conducted only in Dhaka City. However, it would not represent different urban areas of Bangladesh properly. In Bangladesh, no specific data exist about the ASD individuals. So, identifying the residence of children with ASD was quite tough. For this reason, we referred to the 'Parents Forum of Differently Able' to collect data. Besides, most of the guardians did not stay with the children all day long. So, data collection from the guardians was very difficult. Considering the autistic children's limitations in perceiving and answering the questions, no direct questions were asked about their food and digestion problems. In this context, parents or caregivers of autistic children were asked to provide the necessary information. In this regard, respondent bias was possible. Parents of autistic children often avoided interviews to provide information about their children's diet habits because of social superstitions. Furthermore, the data on autism are scarce in Bangladesh. So, were faced with a lack of background information in data analysis. In addition, it was not possible to select to a large number of respondents for data collection due to the time and money constraints. Many of the respondents did not have enough time to give information because of their prestigious fact. As a result, the interviews were shortened. Some of the individuals were physically disabled; so, height measurement may have had some bias.

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Conclusion

Feeding problems associated with digestion and metabolic disorders are the real influencers of the poor nutritional status in individuals with autism. We fund that children and adults with autism consumed nutrients variously. This strongly suggests for dietary interventions along with feeding behavior practices' monitoring to improvise the potential solution of the poor nutritional status. This study provided a good base for further research and evidence-based studies in Bangladesh. Several factors may influence the nutritional status, calorie intake, and nutrient intake, but choosing foods is the first step to improve the health and well-being.

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Authors' contribution

Dr. Dawla A, Munira S and Hawladar M designed the study. Munira S, Hawladar M, and Islam M conducted the study and wrote the manuscript. Hawladar M and Islam M analyzed the data. Islam M designed the paper and all authors read and approved the final manuscript.

Conflict of Interest

None to declare.

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